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POTATO DISEASES AND THEIR CONTROL

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POTATO DISEASES AND THEIR CONTROL

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The greatest limiting factors in the production of a potato crop in Iowa are not soil and climatic conditions, as is generally supposed, but various pests, improper cultural practices and inferior varieties. Diseases not only reduce the yield by killing and stunting the potato vines in the field, but in many cases render the potatoes unsalable by the presence of black scurf, scab, rots and other diseases. A large part of the loss annually suffered by growers can be avoided by the use of healthy seed. This can be secured only by careful selection and seed treatment.

This circular describes somewhat briefly the most important diseases which attack the vines and tubers of the potato plant and also measures for their control.

Fig. 1. Black leg. The signs of the disease begin at the seed piece and run up the stem, which turns inky black and gets soft. The leaves become yellowish and assume an upright position. Finally the plant falls over and dries up.

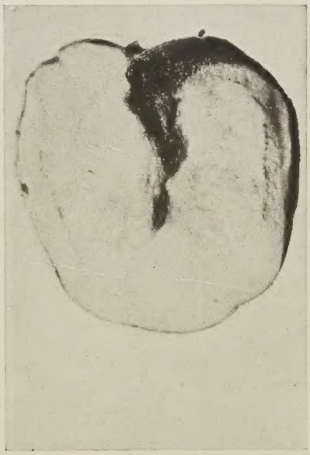

Fig. 2. A black leg infected tuber laid open so as to show the discoloration caused by the disease. Such tubers not only carry the disease over from one year to another but infect others while in the bin. Seed treatment will save those that have the germ clinging to the surface of the seed potato.

BLACK LEG

Black leg is a bacterial disease that lives from one season to the next in the tuber. From infected seed the germs travel from the seed piece into the stem, causing the tissues to rot and turn black. Soon after infection the leaves begin to lose their dark green color, taking on a rolled, yellowish green appearance, and later turn brown and dry up.

Black leg is especially common during warm, wet weather and occurs most frequently in June and July. It may appear at any time until frost, if weather conditions are favorable. It is more common on early Ohios and Irish Cobblers than on the late sorts. It may affect as high as 12 percent of the plants.

Black leg attacks the tubers as well as the vines, entering thru the stem end and causing a discoloration, as shown in fig. 2. Such tubers carry the disease over from one year to another. Seed from the northern part of the United States very frequently is infected.

Control: Since black leg is carried mostly in or on the seed, the seed treatment described later, coupled with field selection, is the most efficient means of control. All tubers with rotten spots or black streaks at the stem end should be discarded. It is also advisable to set aside a certain number of rows as a seed plot. All infected plants should be pulled or rogued out.

LATE BLIGHT

Late blight is one of the most destructive vine diseases known in northern Wisconsin, Minnesota and Michigan, but fortunately in Iowa it is not serious every year. Surveys during 1915, 1916, 1917 and 1918 show that the disease was present each year in Mitchell county, but not seriously destructive except in 1915, when nearly half the crop was destroyed. In 1918 the amount of rot was considerable, but less than in 1915. The damage done is largely dependent on weather conditions. During cool, wet seasons the disease is especially destructive. The first symptoms begin as small, yellowish green, irregular spots on the leaves ,which rapidly turn brown (fig. 4). In cool, moist weather the diseased area may spread over the entire leaf in two days. On the lower surface of the infected spots, a white, mildew-like growth appears, bearing the spores, which rapidly spread from plant to plant. In severe cases a field may be ruined in a few days.

Late blight affects both tubers and vines, and lives over from year to year in the seed. Its presence on the seed is indicated by dark, sunken areas on the surface and a brownish discoloration of the flesh (fig. 3). Such seed, if planted, may start an eqidemic in the field under favorable weather conditions. One infected plant (fig. 5) is sufficient to infect a whole field. In Iowa, the disease is most apt to occur in late August or September.

Control: Altho varieties grown in Iowa are quite susceptible to this disease, the early sorts usually mature before danger of an outbreak, and even on late varieties there is no danger of a serious outbreak unless the weather is wet and cool during August and September. The disease can be effectively controlled by the application of bordeaux mixture. This should be applied at the first sign of the disease, followed by further applications every ten days until the blight is eradicated.

Fig. 3. Late blight on potato tuber. Note the discoloration of the flesh, which is confined to the outer portion of the tuber.

Fig. 4. Late blight on leaves. This fungus trouble begins most often at the leaf margins and destroys the tissues very rapidly during wet weather in August and September.

Fig. 5. Late blight on stem. The fungus grows up stem from infected seed. Such plants start the disease in potato fields in favorable weather.

Fig. 6. Foliage burning may be caused by the attack of leaf hoppers or by weather conditions. The tips and margins of the leaves are killed and turn brown.

FOLIAGE BURNING

Foliage burning, commonly called "blight," may occur on any variety of potatoes during June, July and August. The characteristic symptom is a marginal burning of the leaves (fig. 6), which appears as an irregular brown border or dead leaf tissue. It is quite common for the burned portion to roll up.

One type of burning, known as "hopperburn," has recently been shown to be due to the attacks of small green leaf hoppers, which are present in large numbers in potato fields during July and August. This is doubtless one of the most serious potato diseases in Iowa, often reducing the yield 25 or 30 percent. Another type, which occurs during the hot, dry weather of July and August, is caused by the loss of moisture from the leaves more rapidly than the roots can supply it.

Control: Altho early varieties suffer most, the late sorts are often seriously attacked also. Surface cultivation is recommended to conserve soil moisture and thus prevent too rapid a loss of water from the foliage. Bordeaux mixture is probably the most effective spray. Two applications are sufficient on early sorts, beginning with hot weather, the first June 20 and the second about ten days later. On the late varieties in northern Iowa, about three applications are probably most profitable, applied July 5, July 10 and about August 2. The time to spray must depend upon the coming of the leaf hoppers and the hot, dry weather period.

CURLY DWARF

Curly dwarf is most prevalent in Iowa on home-grown seed stock of the early varieties. It may reduce the yield as much as 12 percent. Its most noticeable symptoms are small, bushy plants with the lower leaves crinkled and curled (fig. 7). The leaf stalks are very brittle and snap off readily when touched. Healthy plants are much softer to the touch than are dwarfed plants. In later stages the plant may lose all of its leaves except a small cluster at the tip and the stem may show numerous black streaks. Dwarfed plants usually produce only one fair-sized tuber, or a few small, irregular-shaped ones, borne on short stolons. It is advisable, therefore, to avoid planting small tubers, as these may be the progeny of plants infected with curly dwarf, which will in turn transmit the disease to the new crop.

Control: The only practicable means of control is to set aside a seed plot and pull or rogue out all plants showing symptoms of this disease,

Fig. 7. Curly dwarf. The two stunted, dwarfed plants at the right are infected with this disease. The one on the left is a healthy plant in the same row

allowing none but healthy plants to mature, as the disease is carried over from year to year in the seed. Neither seed treatment nor spraying is believed to be of any value in the control of curly dwarf.

MOSAIC

Mosaic is a disease similar to curly dwarf in that seed infected by it produces stunted plants. A characteristic symptom is a peculiar mottled appearance of the leaves in early spring, due to numerous yellow spots, irregular in outline and blending with the green area surrounding them. Later this mottled appearance disappears and the leaves become wrinkled, curled or dwarfed, much the same as in curly dwarf. On susceptible sorts it reduces the yield every year about one-third.

Control: The problem of control is rather difficult, inasmuch as the disease is carried over in the tubers and seed once infected is always a disease carrier. Seed treatment is not effective. The disease also attacks closely related plants, such as the tomato, pepper, tobacco, ground cherry and wild nightshade, from which it may spread to the potato. It is carried in the field by plant lice and other sucking insects. The most feasible control measures follow:

1. Avoid planting tomatoes, peppers or ground cherries among potatoes.

2. Keep down all wild plants of the nightshade family, such as black nightshade and wild ground cherry.

3. Use the more resistant varieties, such as Early Ohio and Rural New Yorker, and avoid Bliss Triumph, Green Mountain and Irish Cobbler, which are very susceptible.

EARLY BLIGHT

Early blight is a fungous disease doing little or no damage to potatoes in Iowa. It is more commonly observed on late varieties as small brown spots composed of concentric rings. These spots vary from ⅛ to ½ inch in diameter and bear the spores of the fungus, which cause

new spots on healthy leaves. It is readily controlled by spraying with bordeaux mixture.

BLACK SCURF

Black scurf is a fungous disease more commonly observed on the tubers, but doing most damage to the vines. It infects the stem from the seed piece or from the soil, producing a white felt-like growth on the surface. It often rots off the roots, girdles the stem and causes stunted plants (fig. 8), with compact tops, vertical branches and stunted, curly leaves. In some cases tubers are produced above ground. On the tubers, the fungus develops small black specks known as sclerotia (fig. 9), which are sometimes difficult to distinguish from soil particles. Washing is a good test, as the sclerotia do not wash off readily.

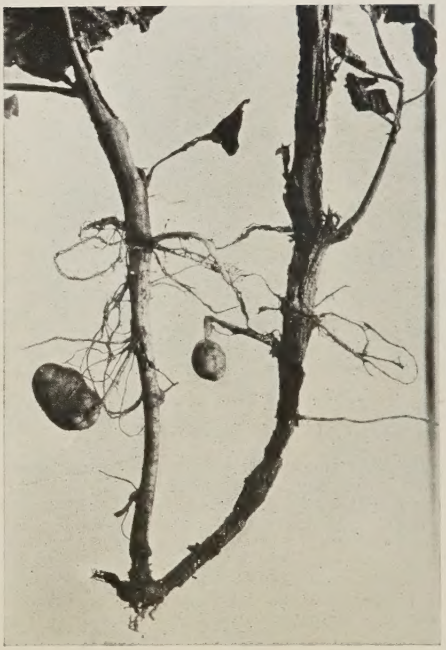

Fig. 8. Here the black scurf fungus has destroyed the outside tissues of the stem on the right, while the one at the left has escaped without much injury. Notice the stolon bearing the tuber has rotted off.

The scurf fungus flourishes best in a poorly drained, acid soil; hence good drainage is a primary requisite for potato land. It is not advisable to apply too much lime to potato ground, because the scab fungus thrives best in a sweet soil.

Control: The only satisfactory control measures are seed treatment and crop rotation. The fungus is carried thru the winter on the seed, as well as in the soil; hence, careful seed treatment will greatly reduce that source of infection.

COMMON SCAB

Potato scab is the most common tuber disease in Iowa, reducing the yield and causing a poor grade of product. It is prevalent both on seed stocks and in the soil.

The symptoms of scab (fig. 10) are well known. The disease produces scabby spots, irregular in size and outline, on the surface of the tuber. In some cases the spots are deep in the flesh, causing brown, discolored areas.

Control: Heavy applications of lime or of barnyard manure greatly aid the scab organism in its development. Well rotted manure can be applied safely before plowing or as a top dressing. The use of healthy treated seed is the most effective means of controlling this disease.

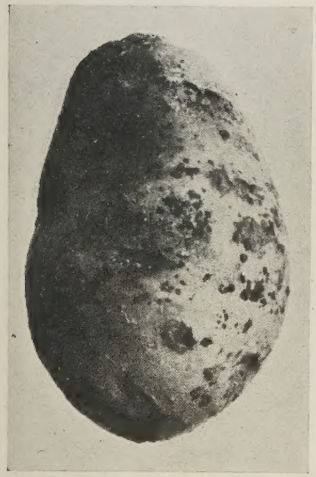

Fig. 9. Black scurf is evident as black dirt-like particles adhering to the tuber. These are masses of fungous threads (sclerotia) which enable the parasite to live over winter and attack the roots and stems again in the spring. Seed treatment kills them.

Fig. 10. Common scab is very conspicuous on the tuber. The scab spots are favorable places for wire worms and insects to feed. Under such conditions the spots become very deep. The disease can be controlled by seed treatment.

TUBER ROTS

Under this heading are grouped those rots which affect the tubers in the field, as well as in storage. In most cases the field rots come either from seed infected the previous year or from the soil, and continue to develop in storage. Other rots develop only in storage, following bruising or improper storage conditions, such as high temperature and poor ventilation.

Stem End Rot: This disease is caused by various fungi which are present in the soil and are carried over from year to year in the tubers. The trouble is evidenced by a decayed or discolored sunken area around the stem end of the tubers (fig. 11). When cut in half longitudinally, a brownish, semi-circular ring is usually observed near the surface of the potato. When a cross section is made near the stem end, a brownish ring (fig. 12) is usually seen. This condition is more common on long sorts. Round sorts like the Rural New Yorker seem quite resistant to the disease.

Jelly End Rot: This disease, as the name indicates, is characterized by the presence of a soft, jelly-like rot, usually at the stem end (fig. 13). In some cases the whole tuber may become infected and develop into a slimy mass. The affected portion is easily separated from the solid portion and, if allowed to dry, disappears and only the skin remains as evidence of the destruction.

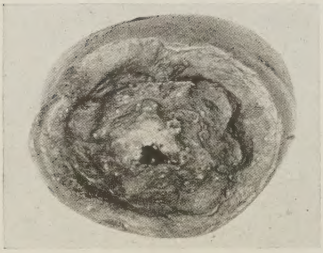

Fig. 11. Stem end rot. This rot is characterized by discolored, sunken appearance around the stem end of the tuber.

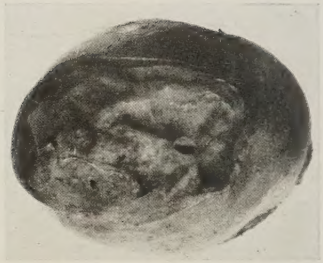

Fig. 13. Jelly end rot. The soft, jelly-like consistency of this rot is very characteristic. The affected tuber becomes a slimy mass of soft pulp.

Dry Rots: Dry rots often cause serious damage to potatoes, especially if the tubers have been bruised or injured before storage. The disease usually enters the potato thru wounds or bruises, causing gradual decay. The tuber seldom gets soft or slimy, but the rot is generally of a dry, grayish color, with a wrinkled surface (fig. 14).

Black Heart: The condition known as black heart (fig. 15) is brought about by over-heating in shipping during the winter. Whenever the temperature rises above 90° F., black heart may result. The center of the potato becomes jet black. It may occur as a dark ring in the center of the tuber, followed by a hollow, dark-bordered cavity. If the discoloration reaches the outside, a rapid decay may set in. Tubers affected with black heart are unfit for seed or food.

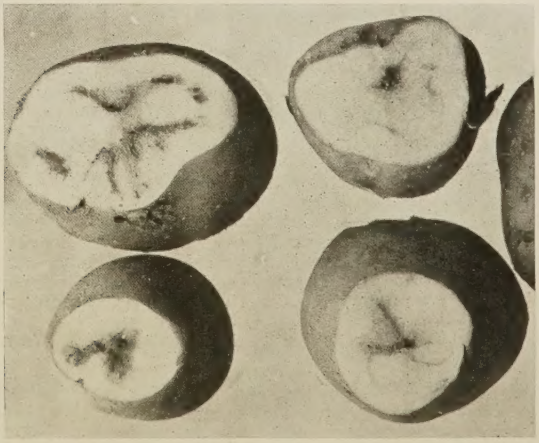

Fig. 12. Stem end rot. The presence of the brown, discolored ring at the stem end of the tuber indicates the invasion of this part by fungi.

Fig. 14. This seed potato was injured at harvest time and placed in poor storage in the fall. The rot started in the wound. It is not safe to cut out the rotten part and plant the rest. Such potatoes spread the disease to others in the bin.

Fig. 15. Black heart is caused by overheating of the potato, either in storage or in cars during shipping.

Control of Tuber Rots: The control measures for tuber rots, so far as known, may be stated briefly as follows:

1. Select seed carefully in the spring, discarding all tubers showing rots or discolored areas.
2. Care should be taken to avoid wounds or bruises in digging. Potatoes handled roughly usually have a high percentage of dry rot.
3. Store or ship potatoes at a low temperature. The best temperature for storage is 34° F.

SEED TREATMENT

Inasmuch as diseased seed may produce a diseased crop, the best seed available should be secured for planting. In addition, all seed should be treated. Most of the diseases described above can be partially or wholly controlled by proper seed treatment. Treatment is so inexpensive that it ought to be a universal practice among growers.

There are several solutions that can be used for treating potatoes. They are (1) hot formaldehyde; (2) cold formaldehyde; (3) mercuric chloride.

HOT FORMALDEHYDE

Recently it has been demonstrated that hot formaldehyde is not only as effective as the cold solutions, but it is less expensive and makes it possible to treat large quantities in a short time, a very important item considering present high-priced labor. Forty to fifty times as many potatoes can be treated in the same length of time in hot

formaldehyde as in cold solutions. This makes it possible for every potato grower to treat his own seed and thereby increase his yield and profit. The treatment, briefly, consists of two pints of 40 percent formaldehyde in 30 gallons of water, held at a temperature of 118° to 122° F., in which the seed is soaked for two minutes, then covered one hour. The seed should be piled 6 to 12 inches deep.

METHODS

For small lots of potatoes up to 25 bushels, the treatment may be made easily in a 15 gallon wash boiler on an ordinary cook stove. The solution should be made up and placed over the fire until the temperature is raised to 122° F. The potatoes may then be dipped in half-bushel lots in sacks. Between lots it may be necessary to reheat the solution.*

When larger lots are to be treated, a convenient method is to use a 75 to 100 gallon tank in which is placed a small heater (fig. 16). This heater can best be made by inserting a piece of eave's spout as a draft flue into a No. 14 ash can, 24 inches high by 18 inches in diameter. Two holes cut in the cover provide for the stovepipe and flue. A third opening in the cover permits the introduction of fuel, either wood or coal. The cost of such a heater is approximately $6.50. Most tank heaters used for heating water for stock are unsatisfactory, due to their being built for a slow fire. Dry wood makes a quick, hot fire, but after the proper temperature is reached, a small amount of coal helps to keep a steady fire. About 75 to 100 bushels per day can be treated by two men with such an equipment.

In treating larger quantities, the work can be done effectively in a stock tank of about 300 gallons capacity. The solution may be heated with steam from a creamery, an upright boiler (fig. 17) or a steam

*A fairly accurate thermometer is necessary for this purpose; a floating thermometer such as is used in creameries is best. These can be purchased for 75 cents to $1.25 each from dairy manufacturing companies, such as J. G. Cherry & Co., Cedar Rapids, and Spurbeck, Lambert & Co., Algona, Iowa. It is well, however, to verify these thermometers with a standard mercury column thermometer. All creameries have such thermometers.

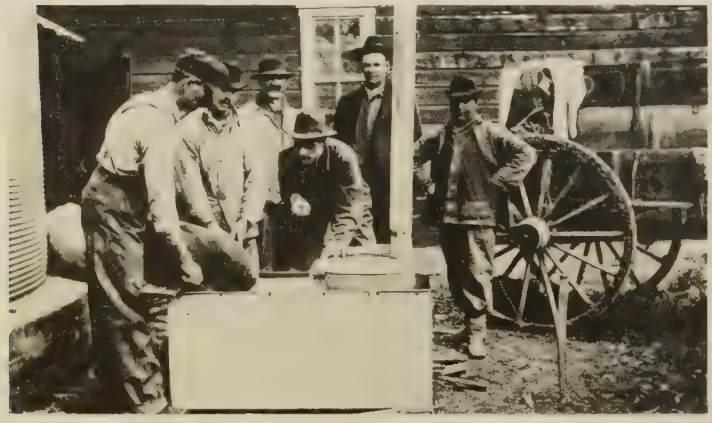

Fig. 16. A simple heater made from an ordinary ash can. This will heat 75 to 100 gallons of solution

Fig. 17. A small steam boiler of the upright type was also found to supply sufficient steam to maintain a temperature between 118 and 122 degrees F. Potatoes were dipped in crates. This method was used to treat enough seed for 20 acres by Sam Kennedy of Clear Lake, Iowa. He raised a good clean crop of potatoes.

Fig. 18. Where large quantities are to be treated, this device may be used effectively. This shows the tank, extension corn crib elevator and the connection with the steam tractor.

engine. The potatoes may be dipped in crates and left in them to dry. From 500 to 1000 bushels per day can be treated with an outfit of this description. It is especially adapted to community cooperation. Seed treatment centers make it possible for several farmers to work together in treating their seed.

The most rapid way of treating is to use a tank and corn crib elevator, as illustrated in fig. 18. The tank may be 14 to 16 feet long, 2½ feet deep and about 2 feet wide, with a capacity of about 400 gallons of solution when in operation. The elevator should be placed in wrong-end-to, and crank attached to the cog wheel at the side. The man operating the crank can determine the length of time the tubers remain in the solution.

COLD FORMALDEHYDE

Thoroly mix 1 pint of formaldehyde (40 percent solution) with 30 gallons of water. Soak the seed two hours, remove and dry. This method is nearly as effective as the mercuric chloride treatment. No poisonous residue is left and the solution can be used for one day without renewal.

MERCURIC CHLORIDE

Dissolve 4 ounces of mercuric chloride in 30 gallons of water. Soak the potatoes in sacks for 1½ hours, remove and dry before cutting. This method is effective, but only a small amount can be treated at once and it is necessary to renew the solution every three or four hours, or make up a new solution. Furthermore, a poisonous residue always remains on the tubers, so that potatoes so treated are unsafe for human or animal food.

THE VALUE OF A SEED PLOT

It is well recognized that selection of seed corn is a valuable practice. Small potatoes are as undesirable for seed as nubbins. They have frequently been produced by weak or diseased plants. The best seed is produced by having a seed plot, which should produce each year enough seed for the following year. Only healthy, medium-sized potatoes, true to variety type, should be planted in such a plot. They should first be treated and during the growing season all diseased plants should be removed, so that only healthy plants will mature. In this way many diseases can be eliminated. When the potatoes from the seed plot are harvested, they should be stored separately.

CERTIFIED SEED

The potato growers of northern Wisconsin and the Red River Valley in Minnesota are producing each year large quantities of potatoes guaranteed within reasonable limits to be free from certain diseases. Such seed is certified by the potato growers' association in those states and sold under their guarantee. It has been found by experiment that in most parts of Iowa such seed produces greater yields than home-grown seed. Its use in Iowa is strongly advised, but it should be treated whenever possible. Seed from Wisconsin is likely to be infected with black scurf, common scab and late blight, and for that reason should be watched very carefully. Seed from the Red River Valley, especially Early Ohio, is often infected with stem end rot and black scurf. Seed treatment is necessary for all seed coming from that section.

VARIETIES FOR IOWA

Among the early sorts, the Early Ohio or Irish Cobbler are best for Iowa conditions. The Ohio is a reddish potato, rather long for its circumference. The Cobbler is a round, white potato with deep eyes.

The Rural New Yorker is recommended as the best late variety for Iowa. It is a round, white potato, quite resistant to black leg, curly dwarf and mosaic. It also suffers less from foliage burning than other varieties grown in the state. Early planting of late varieties is usually best.

POTATO SPRAYING

The foliage diseases of the potato which can be partially or wholly controlled by spraying, are late blight and foliage burning. Late blight becomes serious only in cool, wet seasons, hence the disease which must be given primary consideration is foliage burning. Bordeaux mixture, which gives very good results in the control of these diseases, consists of blue vitriol, lump lime and water in the following proportions:

Blue vitriol	4 pounds
Burned (unslaked) lime	4 pounds
Water	50 gallons

Where only a small patch is to be sprayed the most feasible way to make up the solution is to dissolve 4 pounds of blue vitriol in 25 gallons of water, slake 4 pounds of burned lime and make up to 25 gallons, then pour the two solutions simultaneously into a third container. This insures thoro mixing. The solution can be successfully applied with a knapsack or wheelbarrow sprayer. This is practical only for small patches, however. Fifty gallons of the solution will cover from one-half to three-quarters of an acre. It is not best to make up large quantities of bordeaux mixture in advance, as it loses its strength unless sugar is added at the rate of one ounce to every 25 gallons of solution. The blue vitriol and lime solution will keep indefinitely, if kept well covered to prevent excess evaporation.

If a large acreage is to be covered, it is best to make up stock solutions of lime and blue vitriol. To do this, dissolve 50 to 100 pounds of blue vitriol in as many gallons of water and slake an equal number of pounds of lime in another container. Make the lime solution up to the same strength as the blue vitriol. Then take 4 gallons of such mixture, dilute each to 25 gallons and mix by pouring simultaneously into the spray tank. It is necessary, where one has 5 acres or more, to apply the solution to the vines by means of a spray machine which will develop 150 to 200 pounds pressure.* The greater the pressure, the finer the mist and consequently the greater the benefit from spraying. There are several good types of power sprayers on the market.

SPRAY FOR POTATO BUG

The Colorado or striped potato bug can be controlled by spraying the vines with lead arsenate or paris green. The lead arsenate powder should be used at the rate of one or two pounds to 50 gallons of water or to the same amount of bordeaux mixture. When paris green is used it should be made as follows: For dust spray, 1 pound paris green to 20 pounds of flour or other material. For mist spray use 8 ounces paris green and 1 pound burned lime to 50 gallons of water. The lime is necessary to prevent burning of the foliage.

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*A wheel power triplex pump machine is probably best suited to Iowa conditions. Such machines are made by several different firms. The question of sufficient pressure is very important and duplex pumps are unable to deliver the pressure and maintain it.